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EFFECT OF 4 WEEKS OF MYOFASCIAL RELEASE TECHNIQUE ALONG WITH CONVENTIONAL PHYSIOTHERAPY ON SPASTICITY AND GAIT IN CHILDREN WITH CEREBRAL PALSY- A REPEATED MEASURE DESIGN

Neurophysiotherapy

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ABSTRACT

Purpose: To study the effect of 4 weeks of Myofascial Release Technique to hamstring and tendoachilles muscles along with Conventional Physiotherapy on spasticity and gait in children with Cerebral palsy at the end of 2 weeks and 4 weeks. **Methodology:** This is the Repeated Measure Design study conducted in physiotherapy OPD and IPD were the children with cerebral palsy age between 4 to 15 years were included in the study. Total 20 children underwent the treatment which consist of Myofascial release technique to hamstring and tendoachilles muscle along with conventional physiotherapy and children were assessed at baseline, 2 weeks and 4 weeks using Modified tardieu scale, Physiological cost index, Gait parameters, GMFM-88 and Functional mobility scale. **Statistical analysis used:** The analysis was done using GraphPad Instat 3. For analysing the comparison between Baseline, 2 weeks and 4 weeks, the Repeated Measure ANOVA along with Post Hoc test was used. Results: After the treatment there was seen reduction in spasticity in hamstring and tendoachilles muscle ($p<0.05$) and there was also seen improvement in walking pattern ($p<0.05$). **Conclusions:** The combination of Myofascial release technique on hamstring and tendoachilles muscle along with the conventional physiotherapy after the 4 weeks of the treatment helps in reducing the spasticity, improves walking pattern, efficiency of gait, growth dimension and community walking in children with cerebral palsy with major improvement observed in 2 weeks to 4 weeks period.

KEYWORDS

Spastic diplegic cerebral palsy, Myofascial release, spasticity, MTS, GMFM-88

INTRODUCTION

Cerebral Palsy is a group of permanent disorders of the development of the movement and posture which causes activity limitation. This term is characterized by motor dysfunction due to non-progressive brain damage early in life.[1] Cerebral palsy is leading cause of childhood disability. The incidence of cerebral palsy is approximately 2 to 3 cases per 1000 live births from around the world.[1] In Cerebral Palsy the lesion in the central nervous system frequently results in spasticity of various muscle groups. Spasticity results from alteration within the balance of inputs from reticulospinal and other descending pathways to the motor and interneural circuits of the spinal cord. When the muscle is stretched, the primary afferent fibers that provide the intrafusal fibers of the muscle spindle gets excited and this triggers the monosynaptic excitatory connection with the α motor neuron which supply the stretched muscle and results in contraction of the stretched muscle and excitatory connections with α motor neuron that supplies synergistic muscle.[2] The children with spastic diplegia frequently experience problems with motor control, spasticity, and balance which can cause to gait abnormalities.[3] The abnormal gait patterns in spastic diplegia is related to the subsequent following symptoms like increased muscle tone, a loss of muscle control, deficient equilibrium reactions and relative imbalance of muscle forces across the joints within the lower extremities. Due to motor weakness and poor voluntary motor control the children with spastic diplegic cerebral palsy develop crouch gait or diplegic gait. [4] There are ways to decrease spasticity is by stretching and myofascial release technique.

Myofascial therapy will be defined as the facilitation of mechanical, neural and psycho, physiological adaptive potential as interfaced by the myofascial system.[1][5] The aim of deep myofascial release is to release restrictions or the barriers within the deeper layers of fascia. This is often released by a stretching of the muscular elastic components of the fascia.[5] Myofascial Release (MFR) techniques focus on working through the restrictions within the fascial system, which supports structures of the body. Myofascial Release (MFR) techniques are utilized in a broad range of settings and diagnoses like pain, movement restriction, spasm, spasticity, neurological dysfunction like cerebral palsy, head and birth injury, Cardiovascular Accidents (CVA).[1] Stretching is that the process of elongation and mainly accustomed to reduce spasticity. Stretching results in increase in extensibility of soft tissues by mechanism that involves viscous deformation and structural adaptions of muscles and soft tissues. The aim of stretching is to normalize the tone, to decrease the pain, to improve the soft tissue extensibility and to enhance function.[6] Stretching guides to decrease stiffness, improves movement control, increases in neuron excitability, decreases development of contracture, increases range of motion, improves gait pattern and also reduces the energy during walking. Neurodevelopmental Therapy is hands.on, 'problem solving approach which is employed within the management and treatment of children who have disorders of function, movement or postural control because of damage in their central nervous system. The techniques utilized in facilitation or inhibition of postural reactions and control are guided to supply more movement strategies and graded control.[7]

Gait deficits in children with spastic Cerebral palsy can be considered as primary, secondary or tertiary. Children with cerebral palsy mainly affect these factors due to tonal abnormality, altered muscle performance and postural abnormality which leads to increase in energy expenditure in these children.

The methods of evaluating energy consumption in Cerebral palsy include measurement of oxygen consumption and calculation of the Physiological Cost Index. The physiological cost index assumes a linear relationship between oxygen consumption and heart rate at submaximal levels and so uses heart rate as an indicator of energy expenditure.[8]

The spatiotemporal parameters which incorporate step length, stride length, gait speed and cadence are often applied to evaluate gait development in children and to recognize potential disorders. Additionally, gait in children with Cerebral palsy is characterized by a slower walking speed, a shorter stride length, and longer time spent in double support.[3]

There are various ways to assess spasticity in children with cerebral palsy but the foremost common and useful tool is Modified Tardieu Scale which relies on comparing the threshold angles of muscle reaction to stretches at several predefined velocities.[9]

The gross motor function measure-88 (GMFM-88) scale is employed to plan treatment and detect quantitative changes in gross motor function in children with CP. The improvement motor function over time in children with cerebral palsy can be assessed. The GMFM-88 had good reliability and validity in assessing the gross motor functions of children with cerebral palsy.[10]

The Functional Mobility Scale was developed to quantify mobility in children with Cerebral palsy. It has the potential to document mobility status of children with Cerebral palsy at one point in time and to assess change in mobility status over time.[11]

The need of the study is to find out the effectiveness of long term that is 4 weeks of myofascial release technique on tendoachilles and

hamstring muscle along with conventional physiotherapy which includes stretching and neurodevelopmental therapy to reduce spasticity and improve gait parameters along with Physiological cost index and community walking.

Aim of this study is to study the effect of 4 weeks of Myofascial Release Technique to hamstring and tendoachilles muscles along with Conventional Physiotherapy on spasticity and gait in children with Cerebral palsy at the end of 2 weeks and 4 weeks.

METHODOLOGY

This is a Repeated Measure Design conducted in College of Physiotherapy after getting ethical committee approval from the Institutional Ethical Committee of Physiotherapy College. After obtaining ethical approval, the trial was registered on the clinical trial registry maintained by the Government of India.

There were 20 spastic diplegic children with cerebral palsy, age between 4 to 15 years were recruited in the study. The following inclusion and exclusion criteria were used for selection of children with Cerebral palsy: children with Cerebral palsy should be a clinical diagnosis with spastic diplegic Cerebral palsy, Spastic diplegia patients who were able to walk without support and were therefore classified as Gross Motor Function Classification System level I or II and patients who were able to follow the commands were included in the study. The children who had undergone orthopaedic intervention that is selective dorsal rhizotomy then patient with any medical condition such as cardiovascular disease, and the children who received Botulinum treatment from last 6 months all were excluded from the study. All subjects and their parents received full information about the study and they were provided the written informed consent prior to their participation in the study. All of the 20 children with cerebral palsy received

MFR for tendoachilles muscle –
It was given with patient in prone position. For giving the MFR, finger pads were allowed to sink in to the central portion of the calf as thumb of one hand was placed on a bifurcation of the muscle and thumb of the other hand was placed over the muscle and myofascial release technique was given along a line of muscle fibre and stretch was held for 120 seconds.

MFR for hamstring muscle –
It was given with patient in prone position with ulnar aspect of hands, as hamstring is a large muscle, it is a precise method of giving myofascial release technique by using the ulnar border of hand. Then myofascial structures were stretched and the stretch was maintained up to 120 seconds. MFR for tendoachilles and hamstring muscles were performed for 15 minutes. Following MFR, conventional physiotherapy treatment for 45 minutes was given 5 days in a week for 4 weeks**.**

Fig 1 – MFR to Hamstring muscle

Fig 2 – MFR to tendoachilles muscle

Conventional physiotherapy
which includes stretching and neurodevelopmental therapy program for 45 minutes, 5 times in a week for 4 weeks will be given.

Stretching of tendoachilles muscle: -
Stretching is done to increase dorsiflexion of the ankle, so stretching to the tendoachilles muscle was given. The patients were positioned in the supine lying, then the patient heel was grasped by one hand, and therapist forearm was held along the palmar surface of the foot. The therapist stabilized the anterior aspect of the tibia with another hand and then dorsiflexed the talocrural joint of the ankle by pulling the calcaneus in an inferior direction with their fingers while gently applying pressure in superior direction just proximal to the heads of the metatarsal with forearm.

Stretching to hamstring muscle: -
Stretching is done to increase flexion of hip. The patients were positioned in the supine lying, with hip and knee in 90º of flexion, then the patient's knee was fully extended and the therapist had supported the patient's lower leg with the arm. Then therapist flexed the hip as far as possible.

Fig 3 – Stretching to Hamstring muscle

Fig 4 – Stretching to Tendoachilles muscle
The following techniques were also given to the participants who are included in the study. Single leg standing, Squats, Stepping forward, backward, sideways and Reaching exercises in standing were given.
The outcome measures used were :-

Physiological cost index -
Physiological cost index is used as a simple, indirect measure of oxygen cost during exercise. It is use to determine the efficiency of gait. Firstly, participants were asked to sit comfortably on a chair for 5 minutes till that time resting heart rate was recorded, then the participants were asked to walk 10 mt distance by that time walking pulse rate and speed was recorded and using these data, the Physiological Cost Index was calculated.

Gait Parameters –
Gait was recorded manually, by making the participant walk on a 5-mt stretch of plain white paper with inked foot within a fixed time recorded using a stopwatch. The gait parameters which included were step length, stride length, cadence and gait speed were calculated. Step length was calculated by measuring the distance between heel strike of one extremity to heel strike of opposite extremity.

Stride length was calculated by measuring the distance between heel strike of one extremity to heel strike of same extremity. Cadence was calculated by counting number of steps taken by the participant. Gait speed was calculated by recording the time taken by a participant to complete 5mt distance.

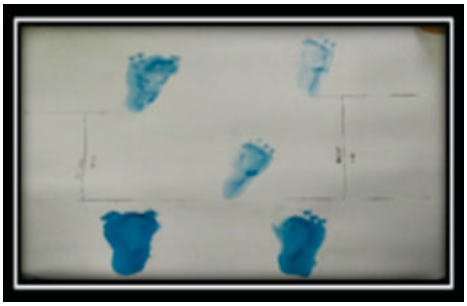

Fig 5 – Footprint (marked step length, stride length

Functional Mobility Scale -
It is scale used to measure the functional mobility of children during walking at 5mt, 50mt, 500mt distance in the home, school and community setting. All the children with cerebral palsy were assessed depending upon their GMFCS level. A brochure of FMS was used and we asked few questions about the child to their parents regarding their usual methods of moving around within the three environments. According to the answers given by the parents we had assigned a score from 1-6 depending on the assistance required for each distance that represents each environmental setting.

Gross Motor Function Measure -88 -
It was used to evaluate the improvement in motor functions at baseline, 2 weeks and 4 weeks after the treatment. We assessed mainly two dimensions that are Dimension D which includes 13 standing components and Dimension E includes walking, running and jumping 24 components. Then we scored the children with cerebral palsy on a scale of 0-3 according to their motor functions and the total score was calculated by summing the score of each dimension and lastly the percentage of each dimension were recorded.

Modified Tardieu Scale –
It is used to measure spasticity that takes into account resistance to passive movement at both slow and fast speed. Modified Tardieu describes R1 and R2; R1 is the angle of muscle reaction, R2 is the full PROM. The angle of full ROM (R2) is taken at a very slow speed (V1). R1 is then subtracted from R2 and this represents the dynamic tone component of the muscle.

Statistical Analysis
Statistical analysis was done using GraphPad Instat 3. For analysing, the comparison between Baseline, 2 weeks and 4 weeks, the Repeated Measure ANOVA was used.

RESULT

Table 1 – Baseline Characteristics

Characteristics	Mean ± SD / %
Age (Mean ± SD)	7.75±3.52
Gender (Male %)	55%
(Female %)	45%

Table 2 - Comparison of Modified Tardieu Scale

Muscle					f value	p value	Significant
		Baseline	2 weeks	4 weeks			
		Mean±SD	Mean±SD	Mean±SD			
Hamstring Right side	R2	111±12.74	112.85±11.69	117.1±10.75	46.52	0.05	Extremely significant
	R1	101.55±15.66	105.05±14.87	110.45±12.76	51.06	0.05	Extremely significant
	R2-R1	9.75±5.61	7.8±5.29	6.6±4.01	15.54	0.05	Extremely significant
Hamstring Left side	R2	108.95±13.36	111.1±11.84	116±10.99	53.03	0.05	Extremely significant
	R1	100.35±14.37	103.35±12.96	109.25±12.02	58.02	0.05	Extremely significant
	R2-R1	8.6±6.16	7.7±6.11	7.15±563	3.23	0.0504	Not quite significant
Tendoachilles Right side	R2	13.4±2.56	16.2±2.50	18.35±1.72	78.60	0.05	Extremely significant
	R1	9.5±2.72	12.15±2.32	15.05±1.98	67.02	0.05	Extreme
	R2-R1	3.85±1.56	4±1.62	3.35±1.38	2.53	0.0924	Not quite significant
Tendoachilles Left side	R2	13.75±2.67	16.15±2.64	19.2±1.47	67.85	0.05	Extremely significant
	R1	9.9±2.82	12.2±2.06	15.65±1.72	21.49	0.05	Extremely significant
	R2-R1	3.75±1.06	3.85±1.38	3.55±1.53	0.43	0.6479	Not significant

Table 3 - Comparison of Physiological Cost Index

Parameters				f value	p value	Significant
	Baseline	2 weeks	4 weeks			
	Mean±SD	Mean±SD	Mean±SD			
Resting HR	77.45±4.78	79.35±5.23	81.65±8.17	1.95	0.1562	Not significant
Walking HR	95.5±11.69	97.45±11.40	96.6±13.19	5.13	0.0106	Significant
Walkin Speed	0.27±0.05	0.30±0.07	0.34±0.09	53.46	0.05	Extremely significant
PCI	0.49±0.25	0.48±0.25	0.45±0.35	0.38	0.6863	Not significant

Table 4 - Comparsion of Gait Parameters

Parameters				F value	p value	Significant
	Baseline	2 weeks	4 weeks			
	Mean±SD	Mean±SD	Mean±SD			
Step Length	37.76±11.79	40.15±11.49	42.45±11.19	90.38	0.05	Extremely significant
Stride Length	67.59±17.47	73.5±17.38	76.5±18.01	46.54	0.05	Extremely significant
Cadence	25.1±9.72	28±9.72	30.25±9.75	29.33	0.05	Extremely significant
Gait speed	0.15±0.03	0.18±0.04	0.21±0.06	72.43	0.05	Extremely significant

Table 5 - Comparison of Gross Motor Function Measures - 88

Dimension				F value	P value	Significant
	Baseline	2 weeks	4 weeks			
	Mean±SD	Mean±SD	Mean±SD			
Dimension D	77.08±13.64	79.12±12.23	81.62±13.50	7.88	0.0014	Very Significant
Dimension E	62.45±13.04	64.90±12.08	67.38±12.32	33.57	0.05	Extremely significant

DISCUSSION

The present study was carried out to evaluate the effectiveness of Myofascial release technique combined the conventional physiotherapy on reducing spasticity and improving gait in children with cerebral palsy. Twenty patients (eleven males, nine females) with percentage of 55% and 45% were recruited within the study. The mean age of the children with cerebral palsy were 7.75±3.52 respectively.

The current study provided the evidences of beneficial effect of Myofascial release technique together with the conventional physiotherapy on reducing spasticity, improving the walking pattern, gait efficiency and growth dimensions in children with cerebral palsy.

There was reduction in spasticity seen in hamstring muscle of right side after the 4 weeks of treatment. The main mechanism for results basically deals with neuroreflexive change that happens within the application of manual force on the musculoskeletal system while giving Myofascial release. It's a hands-on approach which offers afferent stimulation through receptors and provides response by central processing at the spinal cord and cortical levels. Thus, afferent stimulation frequently leads to in efferent inhibition. This principal is employed in Myofascial release technique when the afferent stimulation of a stretch is applied and therefore the operator waits for efferent inhibition to occur so relaxation results.[1] The results of previous study done by Chandan Kumar et al showed same result of that of our study that there was significant difference post R1 value of MTS for calf, hamstring and adductor muscle; whereas no significant difference was found in post R2 value of MTS. This study suggested that there was significant reduction in spasticity also there was equal improvement in balance, proprioception and strength mainly after the treatment Myofascial release technique together with stretching technique.[1]

In the current study, there was improvement was seen through stretching also. Basically, reduction in spasticity suggest that an exaggerated stretch reflex is that the characteristic of muscle spasticity and is primarily due to increased α motor neuron excitability. Stretching results in increase the extensibility of soft tissues by mechanism that involves viscous deformation and structural adaptions of muscles and soft tissues. The structures which are put under tension are muscle, tendon, connective tissues, vascular, dermal and neural tissue.[2][11] The findings of our study were same as that of the study done by Teeraporn Tupimai et al, which suggested that the passive muscle stretching activates Golgi tendon organs and inhibits the excitability of alpha motor neurons and also reduces the motoneuronal excitability which results in increase in the extensibility of soft tissues. Hence, there was reduction within the spasticity of hamstring, soleus, quadriceps and hip adductor muscle in children with cerebral palsy.[12]

In the results of the current study found that there was improvement seen in gross motor function measures after the neurodevelopmental treatment. The mechanism of Neurodevelopmental Therapy is that alignment and symmetry of trunk and pelvis are necessary for proper alignment and symmetry of extremity. Neurodevelopmental Therapy is based on precise handling including facilitation and inhibition, used to provide sensorimotor cues that facilitates change in function. It functions determines the pattern of neural activity supported on input from intrinsic systems & extrinsic variables that establish the context of initiation and execution.[7]

The findings of our study showed significant improvement within the gait parameters that included stride length, step length, gait speed and cadence of the patients with stroke after 4 weeks of the treatment. According to the previous studies done by Chang Ju Kim et al, the comparison was done between normal developmental children and cerebral palsy children it had been observed that walking speed was considerably reduced in children with cerebral palsy. One of the factors responsible are often because of increase tone in one of the group of muscles which doesn't allow relaxation of opposite group and hence required extra effort to walk. Another factor depends, due to the abnormal muscle tension of children with cerebral palsy, in these children their coordination and balance are poor and there are more unusual fluctuations during the process of walking. This kind of walking leads to backward motion of the upper body which manages continuous flexion of the hip joint, and mainly in children with cerebral palsy the trunk angle changes from the either side when children walk.[3]

In the current study, it was found that the Physiological cost index parameters showed significant improvement in steady heart rate and walking speed ($p<0.001$) and resting heart rate and Physiological cost index score showed no significant difference after 4 weeks of treatment. The result of current study showed that Physiological cost index values were reduced as it suggests that children with cerebral palsy required less energy cost of ambulation due to the reduction of spasticity and improvement in walking pattern after the treatment. According to the previous studies, when comparison was done between normal developmental children and cerebral palsy children it had been observed that walking speed was considerably reduced in children with cerebral palsy. One in all the factors responsible may be due to increase tone in one in every of the group of muscles which doesn't allow relaxation of opposite group and hence required extra effort to walk.[11] As within our study it is found out that there is increased in working heart rate, furthermore there is reduced walking speed, mechanism behind it is that an energy of oxygen consummation may only be significantly associated with Physiological Cost Index in the children who have difficulty ambulating, because the increased stress on the cardiovascular system causes a greater elevation of working heart rate, additionally to a decreased speed.[10]

The results of current study also found that reducing the gait abnormality in children with cerebral palsy results in decrease in physiologic demand on the system thus improving their locomotor efficiency.

As the results of our study showed significant improvement within the Function Mobility Scale which has distance measured at 5 mt (at home), 50 mt (at school) and 500 mt (at community). The improvement was seen because there was improvement in walking pattern and reduction in spasticity was observed after the treatment. The gait training was an efficient treatment which helped the children with cerebral palsy to improve community walking.

In the current study it was found that the Gross motor function measures-88 parameters which has Dimension D ($p = 0.0014$) and Dimension E ($p<0.001$) showed significant improvement. There was improvement seen within the dimension D and E is because of improvement in walking pattern of the child and reduction of spasticity within the hamstring muscle. According to Fetters and Kluzik reported that the use of neurodevelopmental treatment for children with Cerebral palsy improved motor skills functionality. Tsorlakis et al evaluated the effect of neurodevelopmental treatment on these functions in children Cerebral palsy. They used GMFM to evaluate the treatment effects and reported significant improvements for gross motor function from the GMFM total scores.[10]

In our study as the children with cerebral palsy were underwent the rehabilitation which focused on reducing the spasticity and improving the gait which helped them to cope up with the higher motor function.

Limitation –

Only spasticity in hamstring and tendoachilles muscle were included. According to Gross motor function classification system only level I and II were included.

Future scope –

Future studies should consider including a greater sample size. Also, it can be do to see the effect of MFR on all affected muscles in children with Cerebral palsy and it can be also done on other types of cerebral palsy as in our study we included only patients with spastic diplegic cerebral palsy.

CONCLUSION

The study concluded that the combination of Myofascial release technique on hamstring and tendoachilles muscle along with the conventional physiotherapy after the 4 weeks of the treatment helps in reducing the spasticity, improves walking pattern, efficiency of gait, growth dimension and community walking in children with cerebral palsy with major improvement observed in 2 weeks to 4 weeks period. Hence MFR could be continued for minimum 4 weeks to achieve lasting effect.

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